

Ecosystem Restoration

Module ER4: Cost Effectiveness/Incremental Cost Analysis and the NER Plan



Student Learning Objectives

The student will be able to:

- Apply the basic concepts of plan evaluation and comparison to ecosystem restoration
- Combine measures into alternatives for Cost-Effectiveness / Incremental Analysis
- Explain how CE/ICA can provide insight for reformulating and developing additional formulation strategies
- Explain plan selection and the identification of the National Ecosystem Restoration (NER) Plan



Informed Decision Making for Ecosystem Restoration Planning

- Traditional B/C Analysis not possible with non-monetary benefits
- Cost-Effectiveness/Incremental Cost Analysis (CE/ICA)
 - offers “next-best” approach
 - bridges the decision-making gap
 - “getting the most for our money”



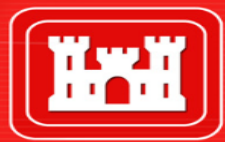
Cost-Effectiveness/Incremental Cost Analysis: Definitions

- Cost-Effectiveness
 - Conducted to ensure that the least cost alternative is identified for each possible level of output
- Incremental Cost Analysis
 - Reveals changes in costs as output levels increase,
 - Allows an assessment of whether the increase in output is worth the additional cost
 - Does not identify unique optimal solution



Cost-Effectiveness/Incremental Cost Analysis: Requirements

- Plans / Alternatives
 - Represent various approaches and scales
- Outputs
 - Clearly identify and quantify
 - Significance must be established
- Costs
 - Appropriate level of detail



Cost-Effectiveness/Incremental Cost Analysis: Result

- Displays how output changes with cost
- Identifies possible breakpoints in this relationship
- Should identify “diminishing returns”
- Provides information to answer “Is It Worth It?”
- Informs and supports selecting recommended plan



Plan Formulation Results:

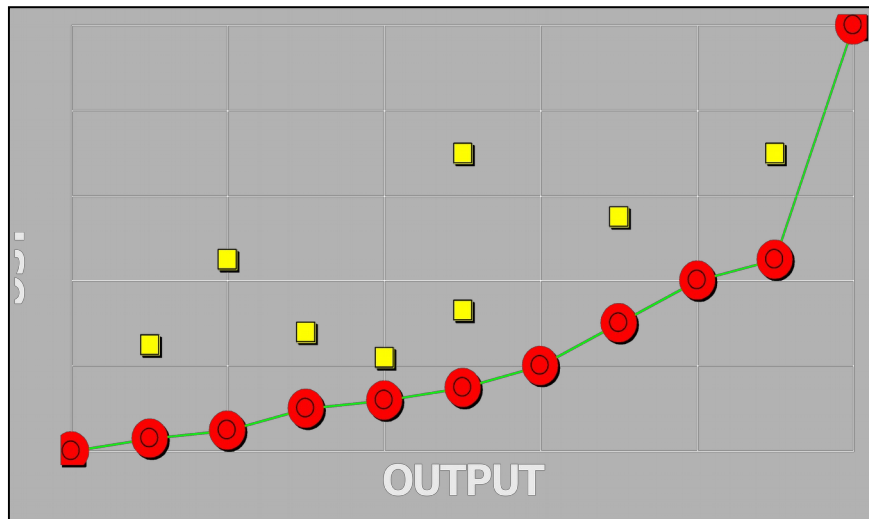
Tabular

Array of
Alternative
Plans, in
Ascending
Order of
Cost

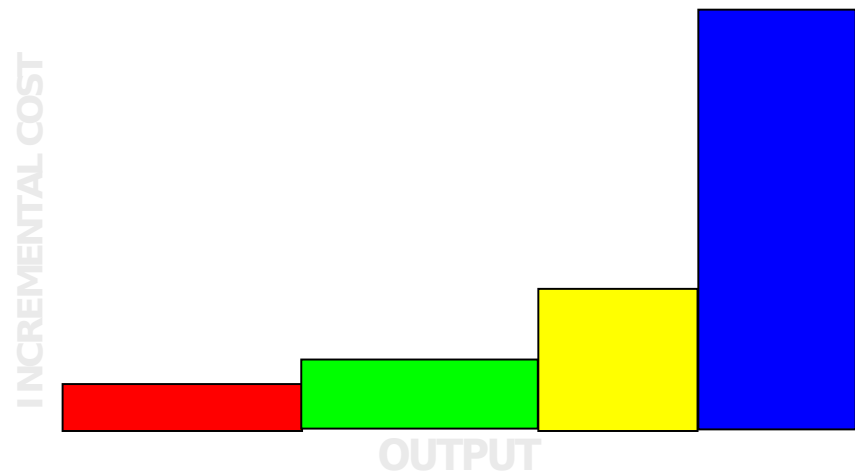
Plan Code	Cost (\$1000)	Output
F1 O0 R4 S0 W0 I0	1150	16
F2 O0 R3 S0 W0 I0	1153	24
F2 O1 R0 S0 W0 I0	1198	58
F3 O0 R3 S0 W0 I0	1219	32
F1 O1 R1 S0 W0 I0	1220	50
F1 O0 R5 S0 W0 I0	1221	16
F4 O0 R3 S0 W0 I0	1262	40
F3 O1 R0 S0 W0 I0	1264	66
F2 O0 R4 S0 W0 I0	1272	24
F1 O2 R0 S0 W0 I0	1281	84
F4 O1 R0 S0 W0 I0	1307	74
F1 O0 R6 S0 W0 I0	1325	16
F1 O1 R2 S0 W0 I0	1327	50
F3 O0 R4 S0 W0 I0	1338	32
F2 O1 R1 S0 W0 I0	1342	58
....
....

Solutions, Costs and Outputs

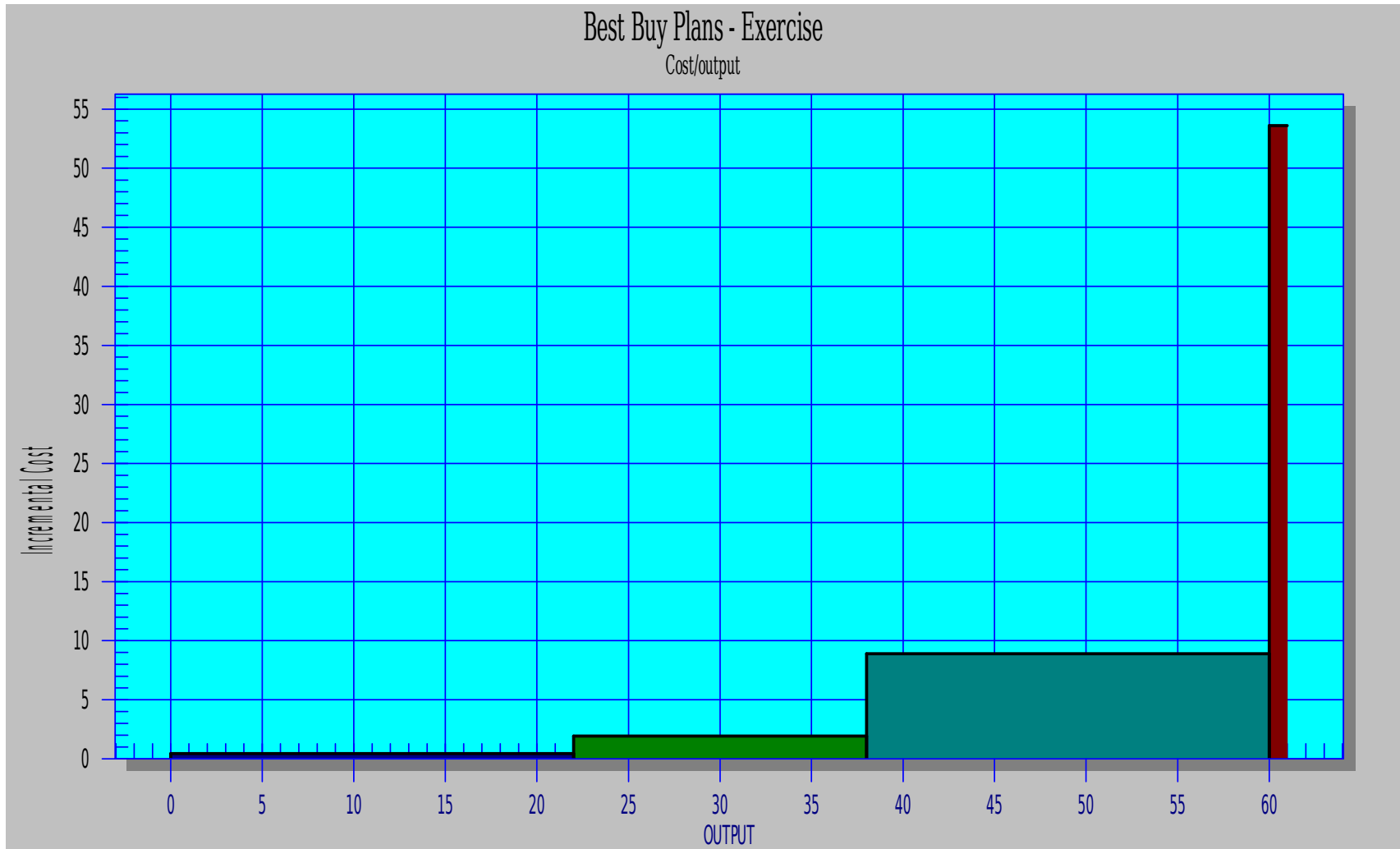
COST EFFECTIVENESS ANALYSIS



INCREMENTAL COST ANALYSIS



Identify Best Buy Alternatives





Basic NER Evaluation Approaches

- **Evaluation by component measures**
 - **Assign costs and outputs at the measure level**
 - **Dependencies/combinability defined for measures**
 - **Potential problems with synergies/redundancies in tracking costs and outputs**
- **Evaluation by plan**
 - **Develop complete alternatives**
 - **Assign costs and outputs at the plan level**
 - **Greater precision for fewer plans**



US Army Corps of Engineers

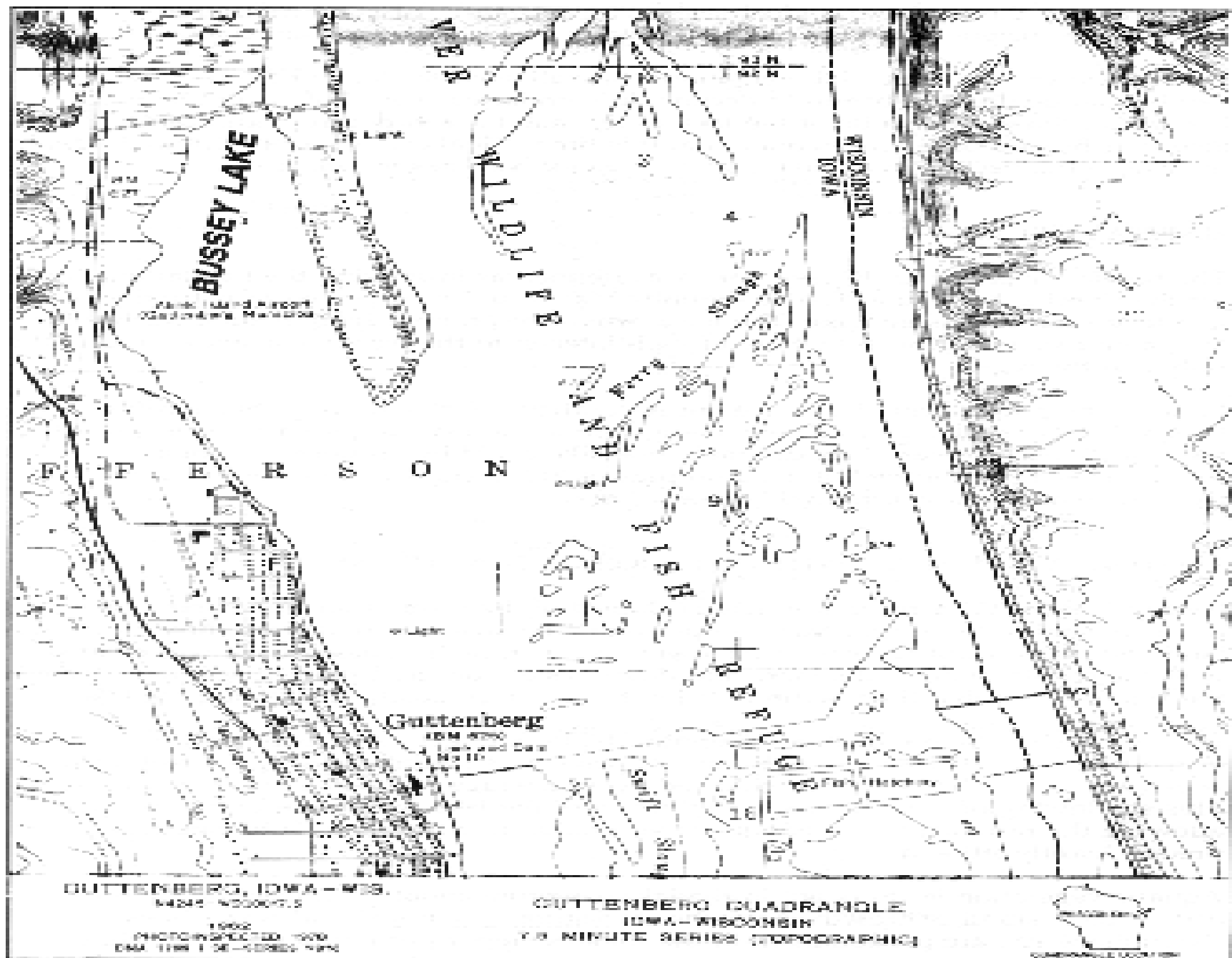


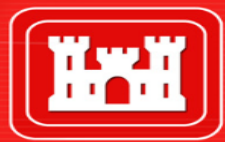
LET'S DO IT!



CE/ICA Exercise: Bussey Lake

- Upper Mississippi River Environmental Management Program
- Exercise includes:
 - Identifying measures
 - Plan building and evaluation by component measure approach
 - Using CE/ICA to assist reformulation and identify new formulation strategies





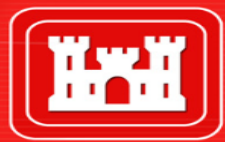
CE/ICA Exercise: Session 1

- Identification of Possible Management Measures



Table A : Component Measures with Costs and Outputs

Scale	Management Measure	Cost (\$1000)	Outputs (HU)
A0	No Action	0	0
A1	Aeration	9.7	22
D0	No Action	0	0
D1	Dredging (140,000 cu. Yds.)	101.6	24
D2	Dredging (220,000 cu. Yds.)	176.2	33
D3	Dredging (270,000 cu. Yds.)	205.2	44
H0	No Action	0	0
H1	Aquatic Plant Harvesting (63 Acres)	28.6	11
H2	Aquatic Plant Harvesting (106 Acres)	30.8	16
S0	No Action	0	0
S1	Improve Substrate	53.6	1



CE/ICA Exercise: Session 2

- Develop Plans Using Component Measures
- Incorporate Dependency and Combinability Relationships

Table B: Plans Sorted By Output

Combinations				Cost (\$1000)	Output (HU)
A0	D0	H0	S0	0	0
A0	D0	H1	S0	28.6	11
A0	D0	H2	S0	30.8	16
A1	D0	H0	S0	9.7	22
A0	D1	H0	S0	101.6	24
A1	D0	H1	S0	38.3	33
A0	D2	H0	S0	176.2	33
A0	D1	H1	S0	130.2	35
A0	D1	H1	S1	183.8	36
A1	D0	H2	S0	40.5	38
A0	D1	H2	S0	132.4	40
A0	D1	H2	S1	186	41
A0	D3	H0	S0	205.2	44
A0	D2	H1	S0	204.8	44
A0	D2	H1	S1	258.4	45
A0	D2	H2	S0	207	49
A0	D2	H2	S1	260.6	50
A0	D3	H1	S0	233.8	55
A0	D3	H1	S1	287.4	56
A0	D3	H2	S0	236	60
A0	D3	H2	S1	289.6	61



CE/ICA Exercise: Assessing Plan Performance

- **Evaluate components of more and less successful plans**
- **Consider whether existing measures fully have been fully exploited in defined plans**
- **Do other Formulation Strategies come to light?**
- **Reformulate!**

Table C.1: Identify Dominated Plans

Combinations				Cost (\$1000)	Output (HU)	Evaluation
A0	D0	H0	S0	0	0	
A0	D0	H1	S0	28.6	11	Non-cost effective
A0	D0	H2	S0	30.8	16	Non-cost effective
A1	D0	H0	S0	9.7	22	
A0	D1	H0	S0	101.6	24	Non-cost effective
A1	D0	H1	S0	38.3	33	
A0	D2	H0	S0	176.2	33	Non-cost efficient
A0	D1	H1	S0	130.2	35	Non-cost effective
A0	D1	H1	S1	183.8	36	Non-cost effective
A1	D0	H2	S0	40.5	38	
A0	D1	H2	S0	132.4	40	
A0	D1	H2	S1	186	41	
A0	D3	H0	S0	205.2	44	Non-cost efficient
A0	D2	H1	S0	204.8	44	
A0	D2	H1	S1	258.4	45	Non-cost effective
A0	D2	H2	S0	207	49	
A0	D2	H2	S1	260.6	50	Non-cost effective
A0	D3	H1	S0	233.8	55	
A0	D3	H1	S1	287.4	56	Non-cost effective
A0	D3	H2	S0	236	60	
A0	D3	H2	S1	289.6	61	



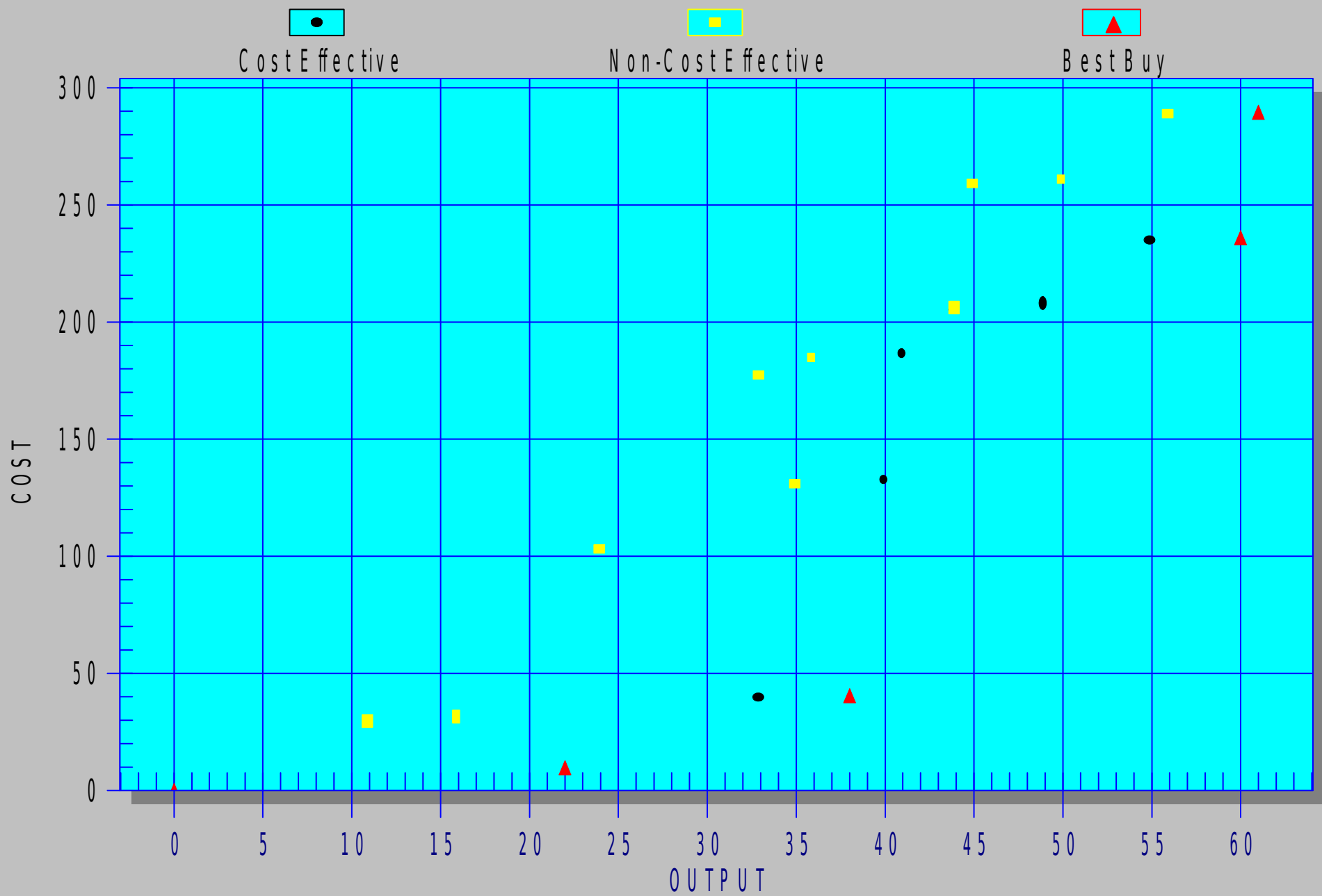
Table C.2: Display Cost-Effective Plans

Combinations				Output (HUs)	Cost (\$1000)
A0	D0	H0	S0	0	0
A1	D0	H0	S0	22	9.7
A1	D0	H1	S0	33	38.3
A1	D0	H2	S0	38	40.5
A0	D1	H2	S0	40	132.4
A0	D1	H2	S1	41	186
A0	D2	H1	S0	44	204.8
A0	D2	H2	S0	49	207
A0	D3	H1	S0	55	233.8
A0	D3	H2	S0	60	236
A0	D3	H2	S1	61	289.6

Figure 3.3

All Plans - Exercise

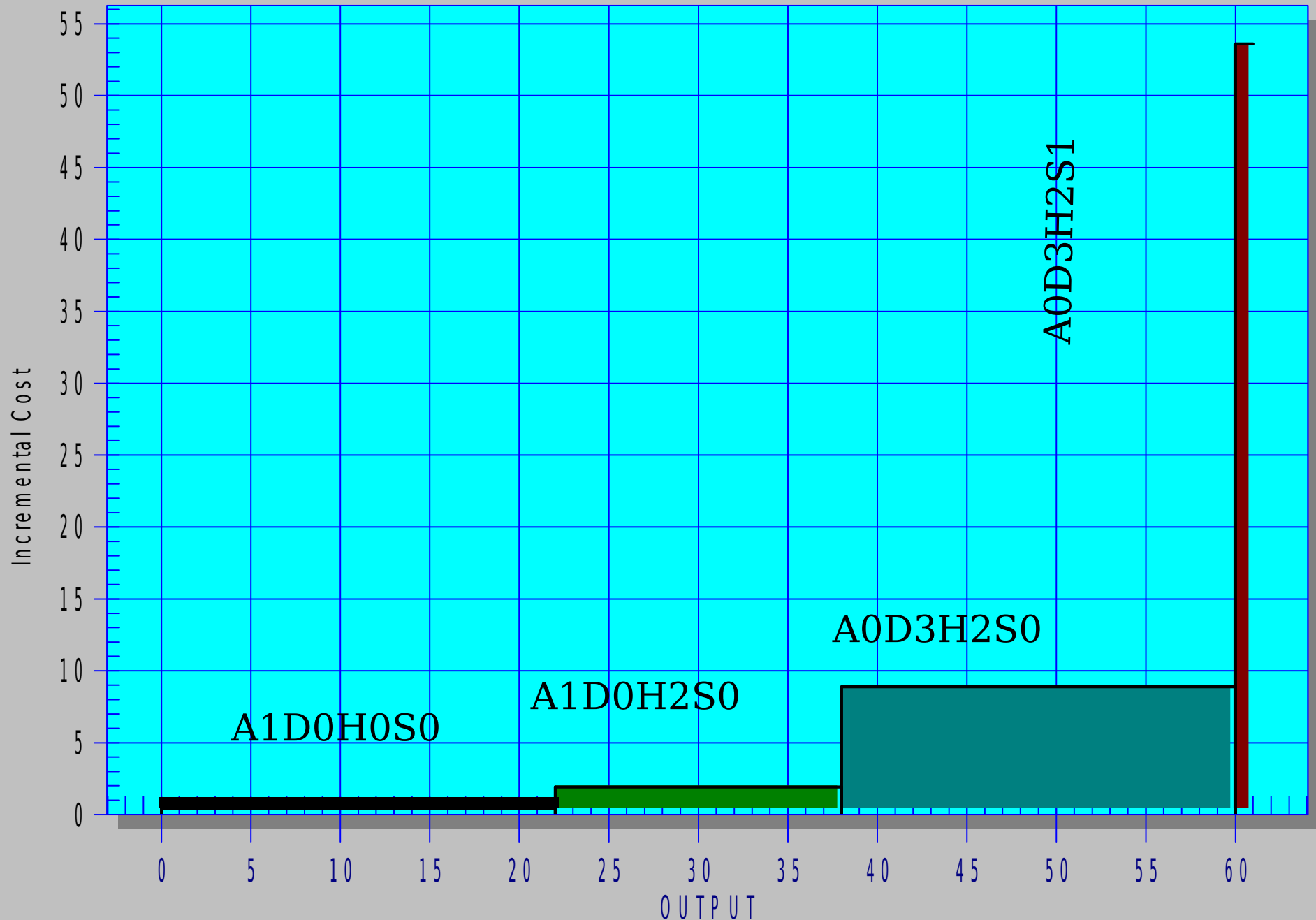
Cost/output



Best Buy Plans - Exercise

Cost/output

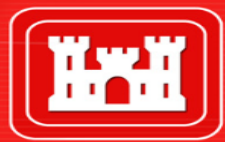
Figure 4.1





IWR-PLAN Features

- Assists Formulation of Plans from Management Measures
 - “Plan Builder” facilitates Component Measures approach
- Assists with Plan Comparison
 - Cost Effectiveness
 - Incremental Cost Analysis
 - Evaluation with either Complete Plan or Component Measures approach
- Assists in Identifying “Best Buy Plans”



IWR-PLAN Features

- Up to 9 output categories
- “Derived” output categories
- Up to 26 solutions, 20 scales each
- Multiple scenarios
- “Plans of Interest”
- Multiple display/ report options
- Import/ Export options and Automated Editing

Availability of IWR-PLAN

- Available on CD or web
- Website: <http://www.pmcl.com/iwrplan>
 - Instructions for USACE certified version
 - Student tutorial
 - Training information
- Contact Person:
 - Darrell.G.Nolton at IWR
 - Darrell.G.Nolton@usace.army.mil



CE/ ICA Results

"getting the most for our money"

**Decision Making
Guidelines**

**Is it worth it?
Recommended Plan**



Comparison of Alternatives

- Planning Objectives & Constraints
- Environmental Compliance Requirements
- P&G Formulation Criteria
- Other Plan Impacts
- Impacts Important to Decision-makers
- Trade-off Analysis Based on Professional Judgment
- Reformulate!



Comparison of Alternatives: Unintended Effects

- Impact on other species
- Residential relocation
- Land ownership
- Other



Plan Selection

- Choices
 - No action (default choice)
 - National Ecosystem Restoration (NER) Plan
 - “locally preferred” plan
- Planner’s perspective
 - Perform good planning
 - Give good advice
 - Ultimately, decision makers select the plan



NER Plan - Definitions

- ER 1105-2-100
 - “... justified alternative & scale having the maximum excess of monetary & non-monetary beneficial effects over monetary & non-monetary costs.”
 - “...occurs where the incremental beneficial effects just equal the incremental costs, or alternatively stated, where the extra environmental value is just worth the extra costs.” (App. E-28.e(1))



NER Plan - Selection Considerations

- Planning Objectives and constraints
- Significance of output
- Reasonably maximizes environmental benefits
- Pass tests of CE/ICA
- Four formulation criteria
 - Completeness
 - Effectiveness
 - Efficiency
 - Acceptability



NER Plan - Additional Considerations

- Partnership context
 - higher budgetary priority to those projects planned in cooperation with other Federal resource agencies & regional & national interagency programs
- Reasonableness of costs
 - decision-maker ascertains that the benefits are really worth the costs
- Rarely will the NER plan not be among the best buy plans (ER1105-2-100 Appendix E, E-41)



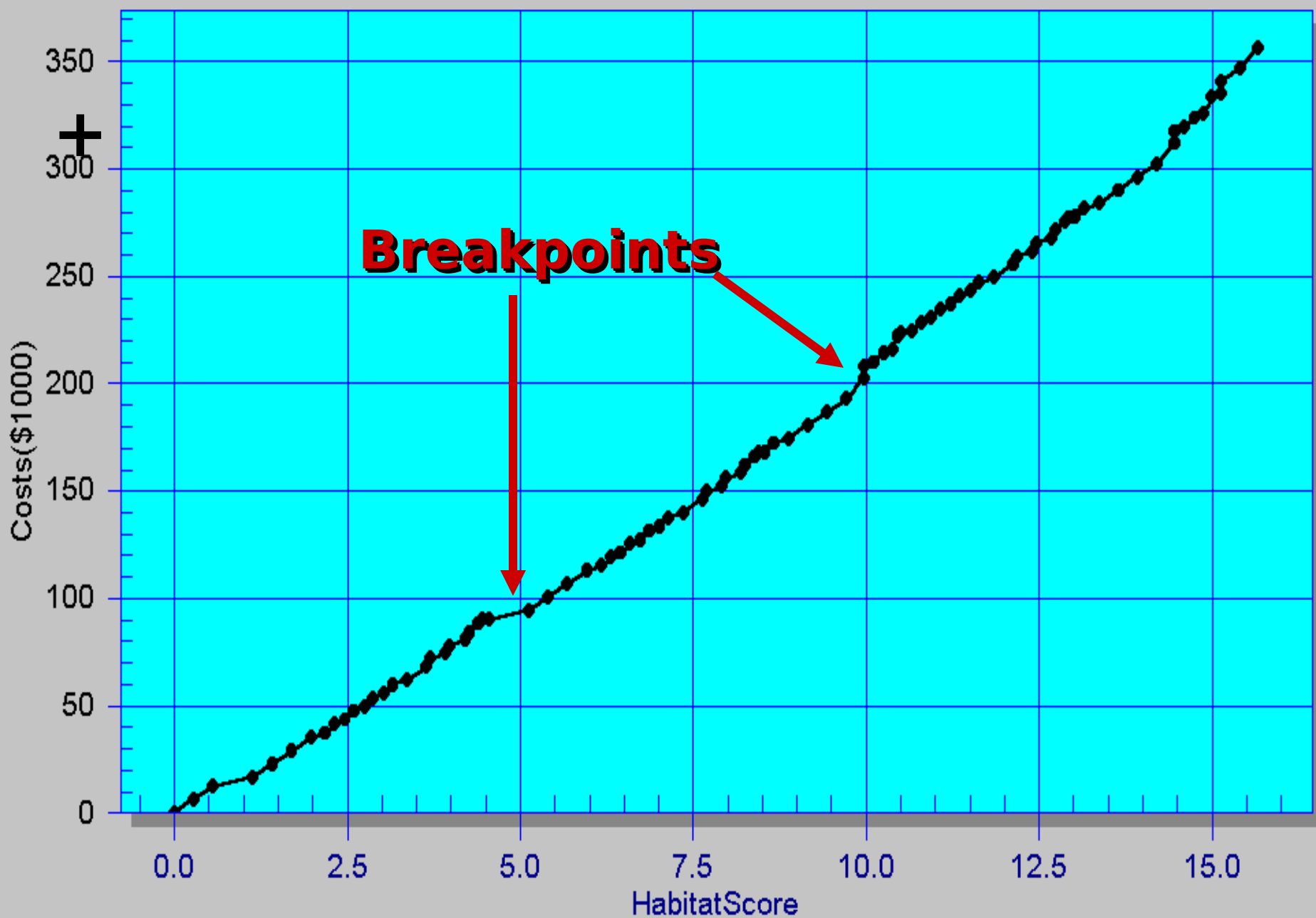
Graphs to Demonstrate Considerations for Selection

- Breakpoints
- Resource Target
- Output Thresholds – minimum and maximum
- Cost Limits

Graphs demonstrate facilities of IWR
PLAN

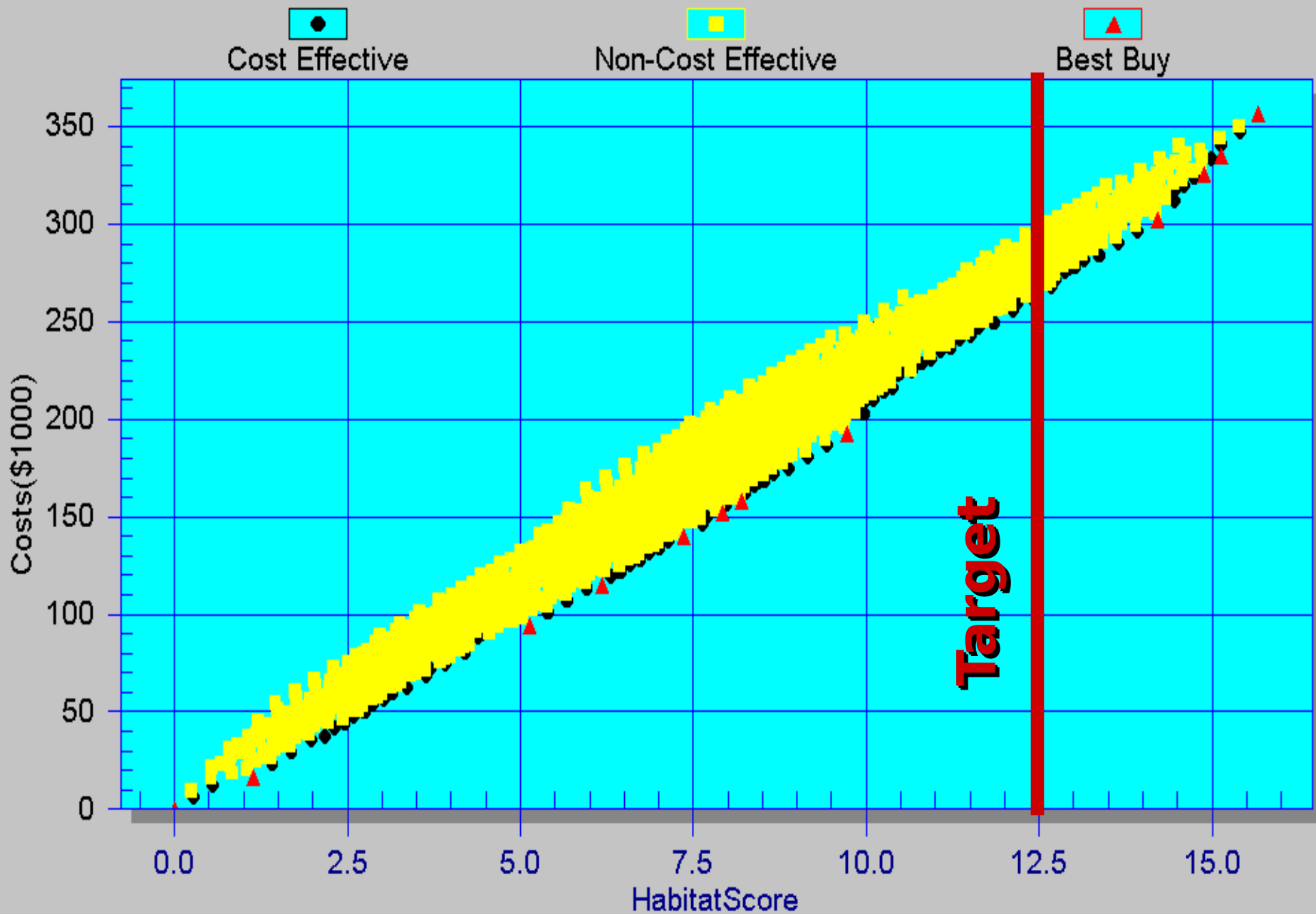
Elizabeth River Environmental Restoration

Wetlands Habitat Assessment - Cost Effective Plans



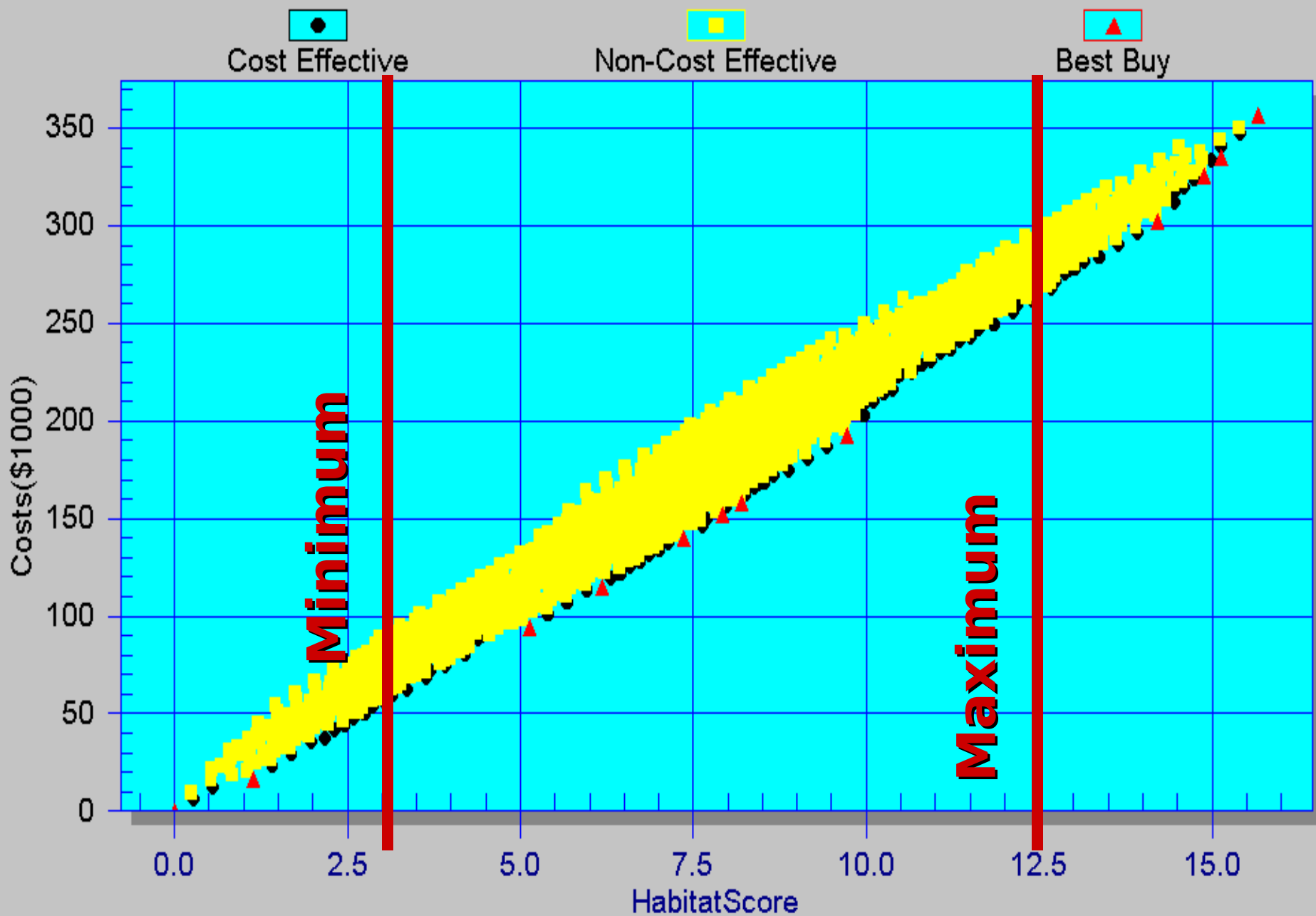
Elizabeth River Environmental Restoration

Wetlands Habitat Assessment - All Plan Combinations



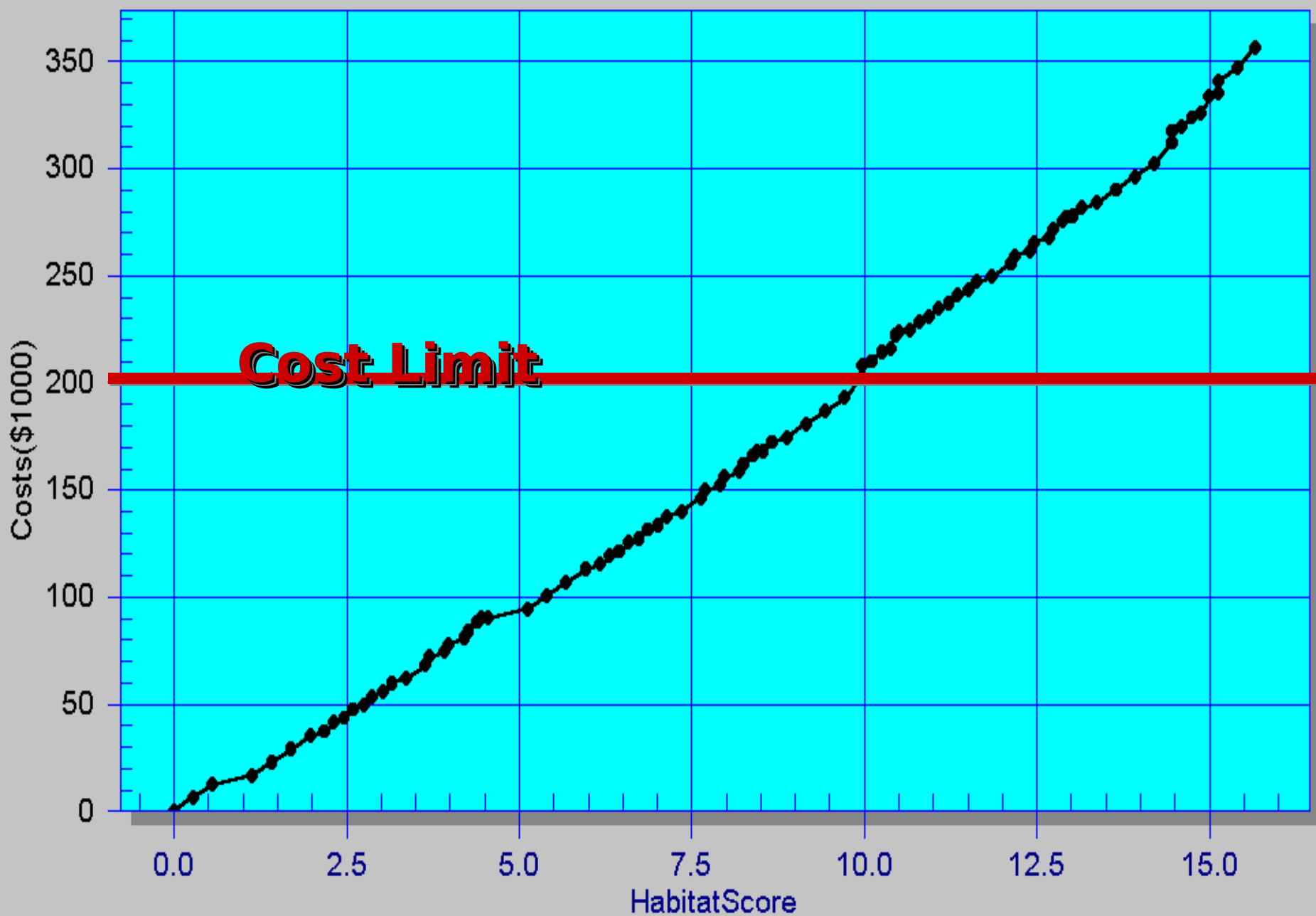
Elizabeth River Environmental Restoration

Wetlands Habitat Assessment - All Plan Combinations



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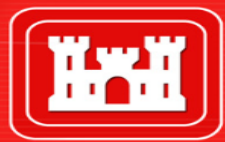
Wetlands Habitat Assessment - Cost Effective Plans





Take Away Points

- CE/ICA offer next-best approaches when project benefits are not measured in dollars
- CE/ICA do not identify a unique or optimal solution
- CE/ICA can identify the least-cost alternative for producing every attainable level of output
- The default choice for plan selection is the no action
- While the normal choice for plan selection is the NER Plan, a LPP is an option



Challenge Questions

- What formulation strategies were employed in this module?
- What other strategies could have been pursued?
- How can CE/ICA inform formulation strategies?